IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

Serial No.: **09/190,207**
Filed: **November 13, 1998**
Group Art Unit: **2643**
Examiner: **Nguyen, D. M.**
Attorney Docket No.: **Chen 4**
Our Ref.: **73-853**

IN RE PATENT APPLICATION OF:

CHEN

TITLE: **METHOD AND APPARATUS FOR REGULARIZING MEASURED HRTF FOR SMOOTH 3D DIGITAL AUDIO**

November 18, 2003

APPEAL BRIEF

Commissioner for Patents
P.O. Box 1450
Alexandria, VA 22313-1450

Sir:

The Applicant submits herewith the following Appeal Brief in triplicate as required by 37 C.F.R. § 1.192.

(1) REAL PARTY IN INTEREST

The real party in interest is Agere Systems Inc.

(2) RELATED APPEALS AND INTERFERENCES

The Applicant and his legal representatives and assignee are not aware of any other appeals or interferences that will directly affect or be directly affected by or have a bearing on the Board's decision in the appending appeal.

(3) STATUS OF THE CLAIMS

Claims 1-12 are pending in this application. Claims 1-12 stand rejected.

(4) STATUS OF ANY AMENDMENT FILED SUBSEQUENT TO FINAL REJECTION

The Applicant has not filed any amendment after final rejection.

(5) SUMMARY OF THE INVENTION

The present invention is directed toward spatial attributes extracted from HRTFs that are regularized before combination with Eigen transfer function filters to provide a plurality of HRTFs with varying degrees of smoothness and generalization.

Regularizing spatial attributes that are extracted from HRTFs allows for a more accurate head-related transfer function (HRTF) model providing a suitable HRTF for source locations in a continuous auditory space without annoying discontinuities.

(6) CONCISE STATEMENT OF THE ISSUES PRESENTED FOR REVIEW

(A) Whether claims 1-12 are obvious under 35 U.S.C. §103(a) over Chen et al., U.S. Patent No. 5,500,900 ("Chen") in view of Abel, U.S. Patent No. 5,659,619 ("Abel").

(7) WHETHER THE CLAIMS STAND OR FALL TOGETHER

Group I: Claims 1-4 stand or fall together because each includes the following distinctive feature:

(1) a plurality of **spatial characteristic functions** derived from time domain head-related transfer functions and adaptively combined with a plurality of Eigen filters.

Group II: Claims 5-8 stand or fall together because each includes the following distinctive feature:

(1) a plurality of **spatial characteristic functions** derived from head-related impulse responses and adapted to be respectively combined with a plurality of Eigen filters.

Group III: Claims 9 and 11 stand or fall together because each includes the following distinctive features:

(1) projecting measured time domain head-related transfer functions back to at least one principal Eigen vector to create **spatial characteristic sets**.

Group IV: Claims 10 and 12 stand or fall together because each includes the following distinctive features:

(1) back-projecting measured head-related impulse responses to at least one principal Eigen vector to create **spatial characteristic sets**.

(8) ARGUMENTS WITH RESPECT TO THE ISSUES PRESENTED FOR REVIEW

(A) Claims 1-4 are not obvious under 35 U.S.C. § 103(a) over Chen in view of Abel.

Rejected claims 1-4 require a plurality of **spatial characteristic functions** derived from time domain head-related transfer functions and adaptively combined with a plurality of Eigen filters.

The Examiner acknowledged that Chen fails to disclose deriving a plurality of spatial characteristic functions and spatial characteristic sets from time domain head-related transfer functions. To cure this serious deficiency, the Examiner cites Abel as allegedly disclosing a spatial characteristic function. In particular, the Examiner alleged that "Abel **inherently** teaches spatial characteristic function (SCFs) derived from head-related impulse responses". (emphasis added).

The Examiner later alleged in the Advisory Action dated September 25, 2003 that since the Examiner does not use the word "inherently" in the body

of the 103 rejection, the response to Applicant's argument is not considered part of the 103 rejection (Advisory Action, page 2).

The Examiner may have inadvertently stated Abel "inherently" discloses spatial characteristic functions since the Examiner stated in the Advisory Action of September 25, 2003 that Abel discloses spatial characteristic functions at Abel's HRTF table 11, fig. 1 **or** weight table 31, fig. 9; col. 2, line 10-30; col. 9, lines 20-37. The Applicant respectfully disagrees.

Abel fails to even mention use of a spatial characteristic function, a **term of art**. A HRTF table and a weight table are **NOT** spatial characteristic functions, as recited by claims 1-4.

Moreover, claims 1-4 recite **deriving** spatial characteristic functions **from** time domain head-related transfer functions. If Abel's HRTF table equates to a spatial characteristic function and a spatial characteristic set, as alleged by the Examiner, Abel's HRTF table would have to be derived from time domain head-related transfer functions to meet the limitations of claims 1-4. Besides being non-sensical, Abel fails to disclose or suggest any such thing, thus not making up for the deficiencies in Chen.

Moreover, rejected claims 1-4 require a plurality of spatial characteristic functions derived from time domain head-related transfer functions and adaptively combined with a plurality of Eigen filters.

Abel fails to even mention use of an Eigen filter, both a **term of art**. If Abel's HRTF table 11 equates to a spatial characteristic function, as alleged by the Examiner, then Abel would at best disclose projecting measured time domain head-related transfer functions back to create a **HRTF** table, **without** use of an Eigen vector. Abel fails to cure the deficiency in Chen.

Alternately, the Examiner alleges Abel's weight table and interpolation function 31 equates to Applicant's spatial characteristic functions in the Advisory Action dated September 25, 2003.

Abel discloses a weight table and interpolation function 31, interpolated weights, a directional matrix and principal component filters are functionally similar to the HRTF table 11 of Fig. 1 (Abel, col. 9, lines 20-37), **NOT**

the weight table and interpolation function 31 alone as alleged by the Examiner. If Abel's weight table and interpolation function 31, interpolated weights, a directional matrix and principal component filters are equivalent to the HRTF table 11, as alleged by the Examiner, then the Examiner would have to argue all of these elements, a weight table and interpolation function 31, interpolated weights, a directional matrix and principal component filters are equivalent to Applicant's spatial characteristic functions. Besides being non-sensical, Abel fails to disclose or suggest any such thing.

If the weight table and interpolation function 31, interpolated weights, a directional matrix and principal component filters are equivalent to spatial characteristic functions, then Abel would have to disclose four elements, the weight table and interpolation function 31, interpolated weights, a directional matrix and principal component filters are derived from time domain head-related transfer functions to meet the limitations the claimed invention. Besides being non-sensical, Abel fails to disclose or suggest any such thing.

Neither Chen nor Abel, either alone or in combination, disclose, teach or suggest a plurality of **spatial characteristic functions** derived from time domain head-related transfer functions and adaptively combined with a plurality of Eigen filters, as recited by claims 1-4

Moreover, even if Abel disclosed spatial characteristic functions (which Abel does not), it is **NOT** simply a matter of adding the spatial characteristic functions to Chen to arrive at the claimed invention. Adding spatial characteristic functions to Chen's invention would require a **complete redesign** of Chen's system to utilize such new elements. Incorporating spatial characteristic functions into a system **NOT** designed to utilize such functions is **NOT** an obvious variation.

It is respectfully submitted that not only does this rejection fail on its face, and thus is improper, but also in light of the above comments its clear that Chen in view of Abel does not render obvious any of claims 1-4. Thus, the rejection of claims 1-4 under 35 U.S.C. § 103(a) is improper and should be reversed.

(B) Claims 5-8 are not obvious under 35 U.S.C. § 103(a) over Chen in view of Abel.

Rejected claims 5-8 require a plurality of **spatial characteristic functions** derived from head-related impulse responses and adapted to be respectively combined with a plurality of Eigen filters.

The Examiner acknowledged that Chen fails to disclose deriving a plurality of spatial characteristic functions from head-related impulse responses. To cure this serious deficiency, the Examiner cites Abel as allegedly disclosing a spatial characteristic function. In particular, the Examiner alleged that "Abel **inherently** teaches spatial characteristic function (SCFs) derived from head-related impulse responses". (emphasis added).

The Examiner later alleged in the Advisory Action dated September 25, 2003 that since the Examiner does not use the word "inherently" in the body of the 103 rejection, the response to Applicant's argument is not considered part of the 103 rejection (Advisory Action, page 2).

The Examiner may have inadvertently stated Abel "inherently" discloses spatial characteristic functions since the Examiner stated in the Advisory Action of September 25, 2003 that Abel discloses spatial characteristic functions at Abel's HRTF table 11, fig. 1 **or** weight table 31, fig. 9; col. 2, line 10-30; col. 9, lines 20-37. The Applicant respectfully disagrees.

Abel fails to even mention use of a spatial characteristic function, a **term of art**. A HRTF table and a weight table are **NOT** spatial characteristic functions, as recited by claims 5-8.

Moreover, claims 5-8 recite **deriving** spatial characteristic functions **from** head-related impulse responses. If Abel's HRTF table equates to a spatial characteristic function, as alleged by the Examiner, Abel's HRTF table would have to be derived from head-related impulse responses to meet the limitations of claims 5-8. Besides being non-sensical, Abel fails to disclose or suggest any such thing, thus not making up for the deficiencies in Chen.

Moreover, rejected claims 5-8 require a plurality of spatial characteristic functions derived from head-related impulse responses and adapted to be respectively combined with a plurality of Eigen filters.

Abel fails to even mention use of an Eigen filter, a **term of art**. If Abel's HRTF table 11 equates to a spatial characteristic function, as alleged by the Examiner, then Abel would at best disclose projecting measured spatial characteristic function back to create a **HRTF** table, **without** use of an Eigen filter. Abel fails to cure the deficiency in Chen.

Alternately, the Examiner alleges Abel's weight table and interpolation function 31 equates to Applicant's spatial characteristic functions in the Advisory Action dated September 25, 2003.

Abel discloses a weight table and interpolation function 31, interpolated weights, a directional matrix and principal component filters are functionally similar to the HRTF table 11 of Fig. 1 (Abel, col. 9, lines 20-37), **NOT** the weight table and interpolation function 31 alone as alleged by the Examiner. If Abel's weight table and interpolation function 31, interpolated weights, a directional matrix and principal component filters are equivalent to the HRTF table 11, as alleged by the Examiner, then the Examiner would have to argue all of these elements, a weight table and interpolation function 31, interpolated weights, a directional matrix and principal component filters are equivalent to Applicant's spatial characteristic functions. Besides being non-sensical, Abel fails to disclose or suggest any such thing.

If the weight table and interpolation function 31, interpolated weights, a directional matrix and principal component filters are equivalent to spatial characteristic functions, then Abel would have to disclose four elements, the weight table and interpolation function 31, interpolated weights, a directional matrix and principal component filters are derived from head-related impulse responses to meet the limitations the claimed invention. Besides being non-sensical, Abel fails to disclose or suggest any such thing.

Neither Chen nor Abel, either alone or in combination, disclose, teach or suggest a plurality of spatial characteristic functions **derived from** head-

related impulse responses and adapted to be respectively combined with a plurality of Eigen filters, as recited by claims 5-8

Moreover, even if Abel disclosed spatial characteristic functions and spatial characteristic sets (which Abel does not), it is **NOT** simply a matter of adding spatial characteristic functions to Chen to arrive at the claimed invention. Adding spatial characteristic functions to Chen's invention would require a **complete redesign** of Chen's system to utilize such new elements. Incorporating spatial characteristic functions into a system **NOT** designed to utilize such functions and sets is **NOT** an obvious variation.

It is respectfully submitted that not only does this rejection fail on its face, and thus is improper, but also in light of the above comments its clear that Chen in view of Abel does not render obvious any of claims 5-8. Thus, the rejection of claims 5-8 under 35 U.S.C. § 103(a) is improper and should be reversed.

(C) Claims 9 and 11 are not obvious under 35 U.S.C. § 103(a) over Chen in view of Abel.

Rejected claims 9 and 11 require projecting measured time domain head-related transfer functions back to at least one principal Eigen vector to create **spatial characteristic sets**.

The Examiner acknowledged that Chen fails to disclose creating a plurality of spatial characteristic sets from time domain head-related transfer functions. To cure this serious deficiency, the Examiner cites Abel as allegedly disclosing a spatial characteristic function. In particular, the Examiner alleged that "Abel **inherently** teaches spatial characteristic function (SCFs) derived from head-related impulse responses". (emphasis added).

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Abel fails to even mention use of a spatial characteristic set, a **term of art**. A HRTF table and a weight table are **NOT** spatial characteristic sets, as recited by claims 9 and 11.

Moreover, claims 9 and 11 recite creating a plurality of spatial characteristic sets from time domain head-related transfer functions. If Abel's HRTF table equates to a spatial characteristic set, as alleged by the Examiner, Abel's HRTF table would have to be derived from time domain head-related transfer functions to meet the limitations of claims 9 and 11. Besides being non-sensical, Abel fails to disclose or suggest any such thing, thus not making up for the deficiencies in Chen.

Rejected claims 9 and 11 require projecting measured time domain head-related transfer functions back to at least one principal Eigen vector to create spatial characteristic sets.

Abel fails to even mention use of an Eigen vector, a **term of art**. If Abel's HRTF table 11 equates to a spatial characteristic set, as alleged by the Examiner, then Abel would at best disclose projecting measured time domain head-related transfer functions back to create a **HRTF** table, **without** use of an Eigen vector. Abel fails to cure the deficiency in Chen.

Alternately, the Examiner alleges Abel's weight table and interpolation function 31 equates to Applicant's spatial characteristic sets in the Advisory Action dated September 25, 2003.

Abel discloses a weight table and interpolation function 31, interpolated weights, a directional matrix and principal component filters are functionally similar to the HRTF table 11 of Fig. 1 (Abel, col. 9, lines 20-37), **NOT** the weight table and interpolation function 31 alone as alleged by the Examiner. If Abel's weight table and interpolation function 31, interpolated weights, a

directional matrix and principal component filters are equivalent to the HRTF table 11, as alleged by the Examiner, then the Examiner would have to argue all of these elements, a weight table and interpolation function 31, interpolated weights, a directional matrix and principal component filters are equivalent to Applicant's spatial characteristic sets. Besides being non-sensical, Abel fails to disclose or suggest any such thing.

If the weight table and interpolation function 31, interpolated weights, a directional matrix and principal component filters are equivalent to spatial characteristic sets, then Abel would have to disclose four elements, the weight table and interpolation function 31, interpolated weights, a directional matrix and principal component filters are created from time domain head-related transfer functions to meet the limitations the claimed invention. Besides being non-sensical, Abel fails to disclose or suggest any such thing.

Neither Chen nor Abel, either alone or in combination, disclose, teach or suggest projecting measured time domain head-related transfer functions back to at least one principal Eigen vector to **create** spatial characteristic sets, as recited by claims 9 and 11.

Moreover, even if Abel disclosed spatial characteristic sets (which Abel does not), it is **NOT** simply a matter of adding the spatial characteristic sets to Chen to arrive at the claimed invention. Adding spatial characteristic sets to Chen's invention would require a **complete redesign** of Chen's system to utilize such new elements. Incorporating spatial characteristic sets into a system **NOT** designed to utilize such functions and sets is **NOT** an obvious variation.

It is respectfully submitted that not only does this rejection fail on its face, and thus is improper, but also in light of the above comments its clear that Chen in view of Abel does not render obvious any of claims 9 and 11. Thus, the rejection of claims 9 and 11 under 35 U.S.C. § 103(a) is improper and should be reversed.

(D) Claims 10 and 12 are not obvious under 35 U.S.C. § 103(a) over Chen in view of Abel.

Rejected claims 10 and 12 require back-projecting measured head-related impulse responses to at least one principal Eigen vector to create **spatial characteristic sets**.

The Examiner acknowledged that Chen fails to disclose creating a plurality of spatial characteristic sets from head-related impulse responses. To cure this serious deficiency, the Examiner cites Abel as allegedly disclosing a spatial characteristic function. In particular, the Examiner alleged that "Abel **inherently** teaches spatial characteristic function (SCFs) derived from head-related impulse responses". (emphasis added).

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Abel fails to even mention use of a spatial characteristic set, a **term of art**. A HRTF table and a weight table are **NOT** spatial characteristic sets, as recited by claims 10 and 12.

Moreover, claims 10 and 12 recite **creating** spatial characteristic sets **from** head-related impulse responses. If Abel's HRTF table equates to a spatial characteristic set, as alleged by the Examiner, Abel's HRTF table would have to be created from head-related impulse responses to meet the limitations of claims 10 and 12. Besides being non-sensical, Abel fails to disclose or suggest any such thing, thus not making up for the deficiencies in Chen.

Moreover, rejected claims 10 and 12 require back-projecting a measured head-related impulse responses to at least one principal Eigen vector to create spatial characteristic sets.

Abel fails to even mention use of an Eigen vector, a **term of art**. If Abel's HRTF table 11 equates to a spatial characteristic function, as alleged by the Examiner, then Abel would at best disclose projecting measured head-related impulse responses back to create a **HRTF** table, **without** use of an Eigen vector. Abel fails to cure the deficiency in Chen.

Alternately, the Examiner alleges Abel's weight table and interpolation function 31 equates to Applicant's spatial characteristic sets in the Advisory Action dated September 25, 2003.

Abel discloses a weight table and interpolation function 31, interpolated weights, a directional matrix and principal component filters are functionally similar to the HRTF table 11 of Fig. 1 (Abel, col. 9, lines 20-37), **NOT** the weight table and interpolation function 31 alone as alleged by the Examiner. If Abel's weight table and interpolation function 31, interpolated weights, a directional matrix and principal component filters are equivalent to the HRTF table 11, as alleged by the Examiner, then the Examiner would have to argue all of these elements, a weight table and interpolation function 31, interpolated weights, a directional matrix and principal component filters are equivalent to Applicant's spatial characteristic sets. Besides being non-sensical, Abel fails to disclose or suggest any such thing.

If the weight table and interpolation function 31, interpolated weights, a directional matrix and principal component filters are equivalent to spatial characteristic sets, then Abel would have to disclose four elements, the weight table and interpolation function 31, interpolated weights, a directional matrix and principal component filters are created from head-related impulse responses to meet the limitations the claimed invention. Besides being non-sensical, Abel fails to disclose or suggest any such thing.

Neither Chen nor Abel, either alone or in combination, disclose, teach or suggest back-projecting a measured head-related impulse responses to

at least one principal Eigen vector to create **spatial characteristic sets**, as recited by claims 10 and 12

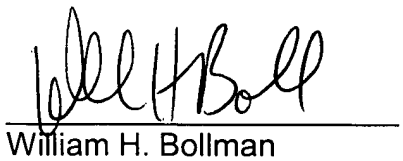
Moreover, even if Abel disclosed spatial characteristic sets (which Abel does not), it is **NOT** simply a matter of adding the spatial characteristic sets to Chen to arrive at the claimed invention. Adding spatial characteristic sets to Chen's invention would require a **complete redesign** of Chen's system to utilize such new elements. Incorporating spatial characteristic sets into a system **NOT** designed to utilize such functions and sets is **NOT** an obvious variation.

It is respectfully submitted that not only does this rejection fail on its face, and thus is improper, but also in light of the above comments its clear that Chen in view of Abel does not render obvious any of claims 10 and 12. Thus, the rejection of claims 10 and 12 under 35 U.S.C. § 103(a) is improper and should be reversed.

CONCLUSION

For all the reasons set forth above, the rejections of claims 1-12 are improper and should be reversed. The Applicant therefore respectfully requests that this Appeal be granted and that the rejections of the claims be reversed.

Respectfully submitted,



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APPENDIX

CLAIMS INVOLVED IN THE APPEAL

1. A time domain head-related transfer function model for use with 3D sound applications, comprising:

a plurality of Eigen filters;

a plurality of spatial characteristic functions derived from time domain head-related transfer functions and adaptively combined with said plurality of Eigen filters; and

a plurality of regularizing models adapted to regularize said plurality of spatial characteristic functions prior to said respective combination with said plurality of Eigen filters.

2. The time domain head-related transfer function model for use with 3D sound applications according to claim 1, further comprising:

a summer operably coupled to said plurality of combined Eigen filters combined with said plurality of regularized spatial characteristic functions to provide said time domain head-related transfer function model.

3. The time domain head-related transfer function model for use with 3D sound applications according to claim 1, wherein:

said plurality of regularizing models are each adapted to perform a generalized spline model.

4. The time domain head-related transfer function model for use with 3D sound applications according to claim 1, further comprising:

a smoothness control operably coupled with said plurality of regularizing models to allow control of a trade-off between localization and smoothness of said time domain head-related transfer function.

5. A time domain head-related impulse response model for use with 3D sound applications, comprising:

a plurality of Eigen filters;

a plurality of spatial characteristic functions derived from head-related impulse responses and adapted to be respectively combined with said plurality of Eigen filters; and

a plurality of regularizing models adapted to regularize said plurality of spatial characteristic functions prior to said respective combination with said plurality of Eigen filters.

6. The time domain head-related impulse response model for use with 3D sound applications according to claim 5, further comprising:

a summer adapted to sum said plurality of combined Eigen filters combined with said plurality of regularized spatial characteristic functions to provide said head-related impulse response model.

7. The time domain head-related impulse response model for use with 3D sound applications according to claim 5, wherein:

said plurality of regularizing models are each adapted to perform a generalized spline model.

8. The time domain head-related transfer function model for use with 3D sound applications according to claim 5, further comprising:

a smoothness control in communication with said plurality of regularizing models to allow control of a trade-off between localization and smoothness of said time domain head-related transfer function.

9. A method of determining spatial characteristic sets for use in a time domain head-related transfer function model, comprising:

constructing a covariance data matrix of a plurality of measured time domain head-related transfer functions;

performing an Eigen decomposition of said covariance data matrix to provide a plurality of Eigen vectors;

determining at least one principal Eigen vector from said plurality of Eigen vectors; and

projecting said measured time domain head-related transfer functions back to said at least one principal Eigen vector to create said spatial characteristic sets.

10. A method of determining spatial characteristic sets for use in a time domain head-related impulse response model, comprising:

constructing a time domain covariance data matrix of a plurality of measured head-related impulse responses;

performing an Eigen decomposition of said time domain covariance data matrix to provide a plurality of Eigen vectors;

determining at least one principal Eigen vector from said plurality of Eigen vectors; and

back-projecting said measured head-related impulse responses to said at least one principal Eigen vector to create said spatial characteristic sets.

11. Apparatus for determining spatial characteristic sets for use in a time domain head-related transfer function model, comprising:

means for constructing a covariance data matrix of a plurality of measured time domain head-related transfer functions;

means for performing an Eigen decomposition of said covariance data matrix to provide a plurality of Eigen vectors;

means for determining at least one principal Eigen vector from said plurality of Eigen vectors; and

means for back-projecting said measured time domain head-related transfer functions to said at least one principal Eigen vector to create said spatial characteristic sets.

12. Apparatus for determining spatial characteristic sets for use in a time domain head-related impulse response model, comprising:

means for constructing a time domain covariance data matrix of a plurality of measured head-related impulse responses;

means for performing an Eigen decomposition of said time domain covariance data matrix to provide a plurality of Eigen vectors;

means for determining at least one principal Eigen vector from said plurality of Eigen vectors; and

means for back-projecting said measured head-related impulse responses to said at least one principal Eigen vector to create said spatial characteristic sets.

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

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2643

TRANSMITTAL LETTER (Large Entity)

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12403

Application Number: **09/190,207**

Group Art Unit: **2643**

Filed: **November 13, 1998**

Examiner Name: **Nguyen, D.M.**

Applicant: Chen

Attorney Docket Number: **73-853**

TITLE: **METHOD AND APPARATUS FOR REGULARIZING MEASURED HRTF FOR SMOOTH 3D DIGITAL AUDIO**

Total Number of Pages in this Submission: 18

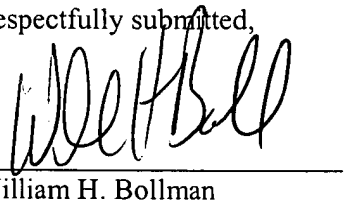
COMMISSIONER FOR PATENTS
P.O. BOX 1450
ALEXANDRIA, VA 22313-1450

SIR:

Transmitted herewith are
an appeal brief in triplicate in the above-identified application (18 Pages)

Attached is a check in the amount of **$330.00** to cover the filing fee. Duplicate copies of this letter are enclosed. The Commissioner is hereby authorized to charge any additional fees required under 37 C.F.R. 1.16 or any patent application processing fees under 37 C.F.R. 1.17 associated with this communication, or credit any over payment to **Deposit Account No. 50-0687 under Order No. 73-853.**

Respectfully submitted,



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Date: November 18, 2003

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